



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/594,907	08/07/2008	Takeshi Sakamoto	46884-5519 (232060)	8322
55694	7590	10/01/2010	EXAMINER	
DRINKER BIDDLE & REATH (DC)			JUNG, MICHAEL	
1500 K STREET, N.W.				
SUITE 1100			ART UNIT	PAPER NUMBER
WASHINGTON, DC 20005-1209			2895	
			NOTIFICATION DATE	DELIVERY MODE
			10/01/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

DBRIPDocket@dbr.com
penelope.mongelluzzo@dbr.com

Office Action Summary	Application No.	Applicant(s)	
	10/594,907	SAKAMOTO ET AL.	
	Examiner	Art Unit	
	MICHAEL JUNG	2895	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 20 July 2010.
 2a) This action is **FINAL**. 2b) This action is non-final.
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-19 is/are pending in the application.
 4a) Of the above claim(s) 16-19 is/are withdrawn from consideration.
 5) Claim(s) _____ is/are allowed.
 6) Claim(s) 1-15 is/are rejected.
 7) Claim(s) _____ is/are objected to.
 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
 10) The drawing(s) filed on 29 September 2006 is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ . |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____. | 6) <input type="checkbox"/> Other: _____ . |

DETAILED ACTION

In response to a previous Office action mailed on 01/29/2010, the Applicant amended the independent claim 1 in a reply filed on 07/20/2010 ("Reply"). The amendment changed the scope of the independent claim 1, and, consequently, the scope of its dependent claims 2-15.

Non-elected claims 16-19 remain withdrawn.

Currently, claims 1-19 are pending.

Response to Arguments

1. The Applicant's arguments filed in the Reply with respect to the previous 35 U.S.C. 112, 2nd paragraph rejection of claims 1 and 8 have been fully considered and are persuasive. The previous 35 U.S.C. 112, 2nd paragraph rejection of claims 1 and 8 have been withdrawn.
2. The Applicant's arguments filed in the Reply with respect to the previous 35 U.S.C. 112, 2nd paragraph rejection of claim 7, however, are not persuasive.

On page 8 of the Reply, the Applicant argues that "the unit of energy is not required to be included in the claim because of its being calculated as the ratio of the energy of the laser light for forming the first modified regions to the energy of the laser light for forming the second modified region." The examiner respectfully disagrees.

As claimed, claim 7 recites "energy of the laser light", not the ratio of the energy of the laser light. Interpreting claim 7 in light of the specification does not apprise the one of ordinary skill that the "energy of the laser light" means the ratio of the energy of the laser light.

Additionally, claims 4 and 5 support the examiner's view that the "energy of the laser light" means energy of the laser light, not the ratio of the energy of the laser light. In each of the claims 4 and 5, the applicant recites energy of the laser light in units of energy (microJoules.). Similar to claims 4 and 5, claim 7 recites energy of the laser light. Therefore, the values of energy as recited in claim 7 must be expressed in units of energy.

3. Applicant's arguments filed in the Reply with respect to the previous 35 U.S.C. 102(b) rejection of claims 1-5 and 35 U.S.C. 103(a) rejections of 6-10, 14 and 15 have been fully considered but they are not persuasive. Although the scope of claims 1-15 has been changed by the Applicant, the examiner applied the same reference(s) in rejecting claims 1-15.

On pages 8-10 of the Reply, the Applicant argues that the "cited references do not disclose certain advantageous features of the claims of the instant application including that when forming a second modified region along the line to cut at a position between the first modified region closest to a rear face of the substrate and the rear face, the fracture extending along the line to cut is generated from the second modified region only to the rear face". The Applicant further argues that the "cited references do not disclose, or even suggest, the newly-added features of the independent claim 1 of the instant application of "when an expandable film bonded to the rear face is expanded, the fracture extending along the line to cut and generated from the second modified region to the rear face advances from the substrate to the laminate part by way

of the first modified regions, whereby the substrate and laminate part can be cut along the line to cut". The examiner respectfully disagrees on both arguments.

Both of the Applicant's arguments are directed to a claim limitation that does not recite positive method step(s). Claim scope is not limited by claims language that suggests or makes optional but does not require steps to be performed. The Federal Circuit Court of Appeals held that "whereby clause in a method claim is not given weight when it simply expresses the intended result of a process step positively recited."

Minton v. Nat'l Ass'n of Securities Dealers, Inc., 336 F.3d 1373, 1381, 67 USPQ2d 1614, 1620 (Fed. Cir. 2003). See MPEP 2111.04.

Here, a limitation of "wherein when an expandable film bonded to the rear face is expanded, the fracture extending along the line to cut and generated from the second modified region to the rear face advances from the substrate to the laminate part by way of the first modified regions, whereby the substrate and laminate part can be cut along the line to cut" does not recite positive process step(s); rather, it expresses intended result and/or use of the process steps positively recited in lines 6-10 of claim 1.

The Naoki teaches all the process steps positively recited in claim 1, method of is capable of resulting or being used as intended in the limitation above. The Applicant is encouraged to further limit claim 1 with process step(s) that positively define the Applicant's invention over the prior art.

Specification

4. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: LASER PROCESSING METHOD OF SINGULATING A SEMICONDUCTOR SUBSTRATE [[SEMICONDUCTOR CHIP]].

Claim Rejections - 35 USC § 112

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

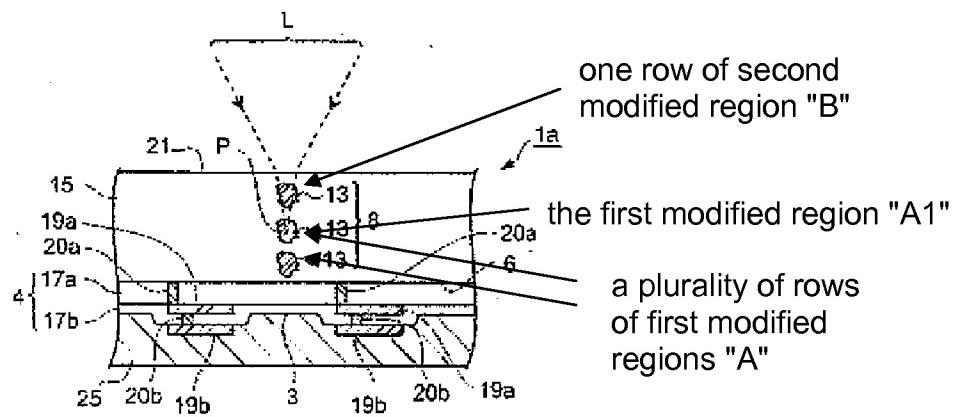
5. Claim 7 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 7 is indefinite, because claim 7 recites energy without appropriate unit of energy. For the purposes of advancing the examination, the examiner assumes the unit of energy to be microJoule (μJ).

Claim Rejections - 35 USC § 102

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. Claims 1-5 are rejected under 35 U.S.C. 102(b) as being anticipated by Japanese Patent Pub. No. JP 2004-001076 to Naoki ("Naoki").



Annotated Drawing 23 of Naoki

Regarding claim 1, Naoki teaches a laser processing method (see Annotated Drawing 23 of Naoki) of

irradiating a substrate 15 (para [0075]) having a front face 6 (para [0052]) formed with a laminate part 4 (para [0022]) including a plurality of functional devices (para [0072] - "...the semiconductor layer laminated for elements exists in many cases...integrated circuit elements..."; see Annotated Drawing 23; see also para [0052].) with laser light L ("L" in Drawing 23; para [0022] discloses that "L" stands for laser beam.) while locating a light-converging point P (see Annotated Drawing 23) within the substrate 15 (para [0331]) so as to form a modified region 8 (para [0073] - "cut starting

point domain") to become a start point for cutting within the substrate 15 along a line to cut (a line that overlaps the melting treatment regions 13 in the thickness direction of the substrate 15; para [0076] - "...If the crack by the melting treatment area 13 is grown up into the thickness direction...the wafer 1a can be also separated.) of the substrate 15,

the method comprising the steps of:

forming a plurality of rows of first modified regions A (see Annotated Drawing 23) along the line to cut; and

forming at least one row of a second modified region B (see Annotated Drawing 23) along the line to cut at a position between the first modified region A1 closest to a rear face 21 of the substrate 15 and the rear face 21 (see Annotated Drawing 23), so as to generate a fracture extending along the line to cut (para [0076] - "...If the crack by the melting treatment area 13 is grown up into the thickness direction...the wafer 1a can be also separated...") from the second modified 13 region to the rear face 21.

Claim scope is not limited by claims language that suggests or makes optional but does not require steps to be performed. The Federal Circuit Court of Appeals held that "whereby clause in a method claim is not given weight when it simply expresses the intended result of a process step positively recited." *Minton v. Nat'l Ass'n of Securities Dealers, Inc.*, 336 F.3d 1373, 1381, 67 USPQ2d 1614, 1620 (Fed. Cir. 2003). See MPEP 2111.04.

Here, a limitation of "wherein when an expandable film bonded to the rear face is expanded, the fracture extending along the line to cut and generated from the second modified region to the rear face advances from the substrate to the laminate part by way

of the first modified regions, whereby the substrate and laminate part can be cut along the line to cut" does not recite a positive process step; rather, it expresses intended result and/or use of the process steps positively recited in lines 6-10 of claim 1.

Since Naoki teaches all the process steps positively recited in claim 1, the method of Naoki is capable of resulting or being used as intended in the limitation above.

Regarding claim 2, Naoki further teaches the substrate 15 that is a semiconductor substrate (para [0052] - "semiconductors (Si)"), and the first and second modified regions A, B that include a molten processed region (para [0075] - "...melting treatment areas 13 are formed in the thickness direction of the substrate 15...").

Regarding claim 3, Naoki further teaches the first and second modified regions A, B that are successively formed one by one from the side farther from the rear face 21 while using the rear face 21 as a laser light entrance surface (see Annotated Drawing 23).

Regarding claim 4, Naoki further teaches the laser light that has an energy of 2 to 50 μ J (para [0032] - "Output: 20 microJ/pulse") when forming first modified regions A.

Regarding claim 5, Fukuyo further teaches the laser light that has an energy of 1 to 20 μ J (para [0032] - "Output: 20 microJ /pulse") when forming the second modified region B.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

7. Claims 6-10, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Naoki.

Regarding claim 6, Naoki discloses that the laser beam penetrates not less than 80% into the silicon substrate 15 (para [0035]). In other words, the energy of a laser beam attenuates as it penetrates into the silicon substrate 15. Thus, it would have been obvious to one of ordinary skill in the art that it would take more energy to form a modified region deeper in the silicon substrate than to form shallower modified regions.

At the time of the invention, it would have been obvious to one of ordinary skill in the art to employ a laser light having a greater energy when forming the first modified regions than when forming the second modified regions as taught by Naoki, so as to keep the size of the modified regions relatively similar to each other as shown in Annotated Drawing 23.

Regarding claim 7, Naoki neither specifies the energy of the laser light for forming the first modified region that is 1.6 to 3.0 μJ nor the energy of the laser light for forming the second modified region that is 1 μJ .

However, Naoki teaches locally heating a substrate by depositing a laser power density between at least $1 \times 10^8 \text{ W/cm}^2$ and $1 \times 10^{12} \text{ W/cm}^2$ to form a "melting treatment area" (para [0031]). Moreover, a pulse width of the laser is between 1 to 200 nanoseconds (para [0031]) and a laser light-spot cross-section area is $3.14 \times 10^{-8} \text{ cm}^2$

(para [0032]). The product of the laser power density, the pulse width and the laser light-spot cross-section yields an energy of the laser.

The energy of the laser is a result effective variable. In light of Naoki's teaching (see rejection of claim 6), it would have been obvious to one of ordinary skill in the art that it would take more energy to form the first modified region than the second modified region (that is, the first modified region is situated deeper in the substrate than the second modified region.), it would have been obvious to one having ordinary skill in the art at the time of the invention was made to select the energy of the laser for forming the first modified region that is 1.6 and 3.0 μJ and the energy of the laser for forming the second modified region that is 1 μJ , since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim 8, Naoki discloses the light-converging point P of the laser light L that is located in about half way in between the substrate in the substrate thickness direction. Since Naoki teaches that the substrate 15 can have various thicknesses such as 100 microns (para [0033] and [0034]), it would have been obvious to one of ordinary skill in the art that the respective portion where the light-converging point of the laser light is located when forming neighboring first modified regions 13, 13 have a distance of 24 to 70 microns therebetween.

Regarding claim 9, Naoki discloses the light-converging point P that is located in about half way in between the substrate in the substrate thickness direction. Since Naoki teaches that the substrate 15 can have various thicknesses such as 100 microns

(para [0033] and [0034]), it would have been obvious to one of ordinary skill in the art that the light-converging point P of the laser light L is located at a position distanced by 50 micron to 180 micron from the rear face 21 when forming the first modified regions 13, 13.

Regarding claim 10, Naoki discloses the light-converging point P that is located in about half way in between the substrate in the substrate thickness direction. Since Naoki teaches that the substrate 15 can have various thicknesses such as 100 microns (para [0033] and [0034]), it would have been obvious to one of ordinary skill in the art that the light-converging point P of the laser light L is located at a position distanced by 20 micron to 110 micron from the rear face 21 when forming the first modified regions 13, 13.

Regarding claim 14, Naoki discloses the light-converging point P that is located in about half way in between the substrate in the substrate thickness direction. Since Naoki teaches that the substrate 15 can have various thicknesses such as 100 microns (para [0033] and [0034]), it would have been obvious to one of ordinary skill in the art that the light-converging point P of the laser light L is located when forming the second modified region 13 closest to the rear face 21 of the substrate 15 is distanced from the rear face 21 by 20 micron to 110 micron, and a position where the light-converging point P of the laser light L is located when forming the second modified region second closest to the rear face 21 of the substrate is distance from the rear face by 140 microns or less (see Annotated Drawing 23).

Regarding claim 15, Naoki further teaches the step of cutting the substrate 15 and the laminate part 4 along the line to cut (para [0076]).

8. Claims 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Naoki and further in view of European Patent Pub. No. EP 1 338 371 A1 to Fukuyo ("Fukuyo").

Regarding claim 11, Naoki discloses that the laser beam penetrates not less than 80% into the silicon substrate 15 (para [0035]). In other words, the energy of a laser beam attenuates as it penetrates into the silicon substrate 15. Thus, it would have been obvious to one of ordinary skill in the art that it would take more energy to form a modified region deeper in the silicon substrate than to form shallower modified regions.

At the time of the invention, it would have been obvious to one of ordinary skill in the art to employ a laser light having a greater energy when forming the first modified regions than when forming the second modified region as taught by Naoki, so as to keep the size of the modified regions relatively similar to each other as shown in Drawing 23.

Naoki does not explicitly disclose forming a plurality of rows of second modified regions.

However, Fukuyo teaches forming a plurality of rows of modified regions (see Fig. 92 for example) that is more than three rows as disclosed by Naoki.

At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of forming modified regions of Naoki by forming more than three rows of the modified regions as taught by Fukuyo, so as to cut a thicker substrate

and/or to make it easier to generate and extend a crack that reaches both sides of the substrate (Naoki, para [0036]).

Regarding claim 12, the modified method taught by the combination of Naoki and Fukuyo does not disclose the energy of the laser light for forming the second modified region farthest from the rear face of the substrate that is 1.3 to 3.3 μJ ; or the energy of the laser light for forming the second modified region closest to the rear face of the substrate that is 1 μJ .

However, Naoki teaches locally heating a substrate by depositing a laser power density between at least $1 \times 10^8 \text{ W/cm}^2$ and $1 \times 10^{12} \text{ W/cm}^2$ to form a "melting treatment area" (para [0031]). Moreover, a pulse width of the laser is between 1 to 200 nanoseconds (para [0031]) and a laser light-spot cross-section area is $3.14 \times 10^{-8} \text{ cm}^2$ (para [0032]). The product of the laser power density, the pulse width and the laser light-spot cross-section yields the energy of the laser.

The energy of the laser is a result effective variable. In light of Naoki's teaching (see rejection of claim 6), it would have been obvious to one of ordinary skill in the art that it would take more energy to form the second modified region that is farthest from the rear face of the substrate than the second modified region that is closest to the rear face (that is, the second modified region farthest from the rear face is situated deeper in the substrate than the second modified region closest to the rear face.). Furthermore, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to select the energy of the laser for forming the second modified region farthest from the rear face of the substrate that is 1.3 and 3.3 μJ and the energy

of the laser for forming the second modified region closest to the rear face of the substrate that is 1 μJ , since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim 13, the modified method taught by the combination of Naoki and Fukuyo does not disclose the energy of the laser light for forming the first modified region that is 1.3 to 3.3 μJ ; or the energy of the laser light for forming the second modified region closest to the rear face of the substrate that is 1 μJ .

However, Naoki teaches locally heating a substrate by depositing a laser power density between at least $1 \times 10^8 \text{ W/cm}^2$ and $1 \times 10^{12} \text{ W/cm}^2$ to form a "melting treatment area" (para [0031]). Moreover, a pulse width of the laser is between 1 to 200 nanoseconds (para [0031]) and a laser light-spot cross-section area is $3.14 \times 10^{-8} \text{ cm}^2$ (para [0032]). The product of the laser power density, the pulse width and the laser light-spot cross-section yields the energy of the laser.

The energy of the laser is a result effective variable. In light of Naoki's teaching (see rejection of claim 6), it would have been obvious to one of ordinary skill in the art that it would take more energy to form the first modified region than the second modified region that is closest to the rear face (that is, the first modified region is situated deeper in the substrate than the second modified region closest to the rear face.). Furthermore, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to select the energy of the laser for forming the first modified region that is 1.3 and 3.3 μJ and the energy of the laser for forming the second modified region

closest to the rear face of the substrate that is 1 μ J, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure: Pub. No. US 2007/0287267 A1 to Sakamoto et al. (see Fig. 19).
10. The previous rejections of claims 1-15 have been maintained despite the Applicant's amendments to the claims.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MICHAEL JUNG whose telephone number is (571) 270-3345. The examiner can normally be reached on M-F from 8:30 AM to 8 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Drew Richards can be reached on (571) 272-1736. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MICHAEL JUNG/
Examiner, Art Unit 2895
25 September 2010

/N. Drew Richards/
Supervisory Patent Examiner, Art Unit 2895